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# Application Scenario for Semantic Annotation of Image Collections

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## 1 Overview

In this demo we show how ontologies can be used to support annotation and search in image collections. Figure 1 shows the general architecture we used within this study. For this study we used four ontologies (AAT, WordNet, ULAN, Iconclass) which were represented in RDF Schema. The resulting RDF Schema files are read into the tool with help of the SWI-Prolog RDF parser<sup>1</sup>. The tool subsequently generates a user interface for annotation and search based on the RDF Schema specification. The tool supports loading images and image collections, creating annotations, storing annotations in a RDF file, and two types of image search facilities.

For this study we used four thesauri, which are relevant for the art-image domain:

1. The Art and Architecture Thesaurus (AAT) is a large thesaurus containing some 125,000 terms relevant for the art domain. The terms are organized in a single hierarchy.
2. WordNet is a general lexical database in which nouns, verbs, adjectives and adverbs are organized into synonym sets, each representing one underlying lexical concept. WordNet concepts (i.e. “synsets”) are typically used to describe the content of the image. In this study we used WordNet version 1.5, limited to hyponym relations.
3. Iconclass is an iconographic classification system, providing a hierarchically organized set of concepts for describing the content of visual resources. We used a subset of Iconclass.
4. The Union list of Artist Names (ULAN) contains information about around 220,000 artists. A subset of 30,000 artists, representing painters, is incorporated in the tool.

For annotation and search purposes the tool provides the user with a description template derived from the VRA 3.0 Core Categories. The VRA template is defined as a specialization of the Dublin Core set of metadata elements, tailored to the needs of art images. The VRA Core Categories follow the “dumb-down” principle, i.e., a tool can interpret the VRA

<sup>1</sup>For more information see: J. Wielemaker *et al.* (2003) Prolog-based infrastructure for RDF: performance and scalability. *Proceedings ISWC’03*

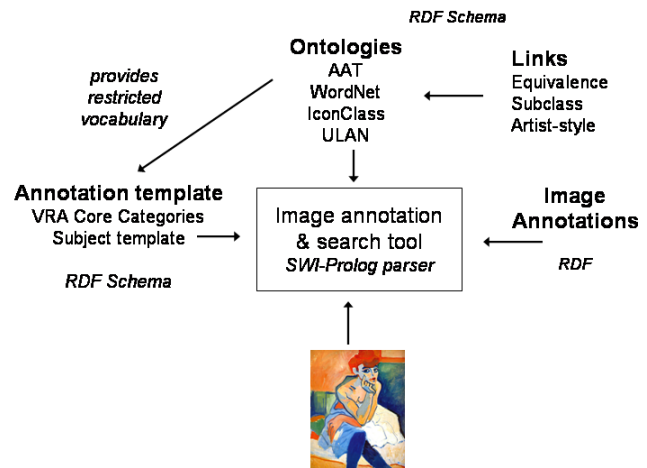


Figure 1: Tool architecture.

data elements as Dublin Core data elements. The subject of the image is described with a collection of statements of the form “*agent action object recipient*”. Each statement should at least have an agent (e.g. a portrait) or an object (e.g. a still life). The terms used in the sentences are selected from terms in the various thesauri.

Where possible, a slot in the annotation template is bound to one or more relevant subtrees of the ontologies. For example, the VRA slot *style/period* is bound to two subtrees in AAT containing the appropriate style and period concepts.

The four ontologies contain many terms that are in some way related. For example, WordNet contains the concept *wife*, which is in fact equal to the AAT concept *wives*. We added three types of ontology links: (1) equivalence relations, (2) subclass relations, and (3) domain-specific relations: e.g., artist to style.

## 2 Demo Excerpts<sup>2</sup>

### 2.1 Annotating art-historic features

Figure 2 shows a screenshot of the annotation interface. In this scenario the user is annotating an image of a painting

<sup>2</sup>Other functionality includes transforming existing annotations and annotating image content.

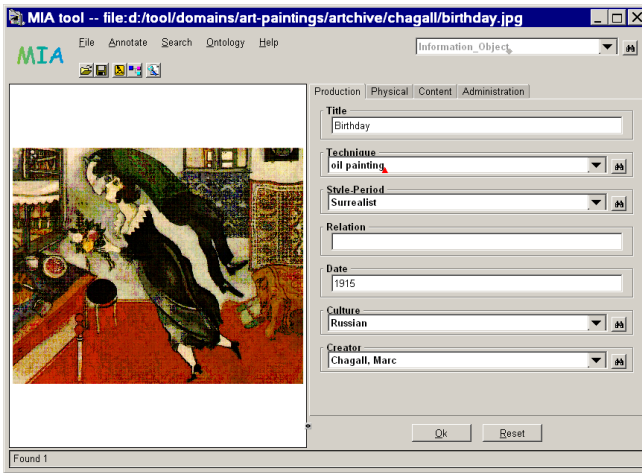


Figure 2: Screenshot of the annotation interface.

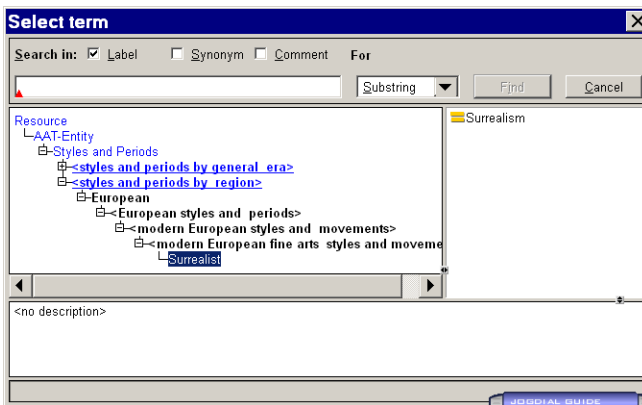


Figure 3: Browser window for values of style/period.

by Chagall. The figure shows the tab for production-related VRA data elements. The four elements with a “binoculars” icon are linked to subtrees in the ontologies, i.e., AAT and ULAN. For example, if we would click on the “binoculars” for style/period the window shown in Figure 3 would pop up, showing the place in the hierarchy of the concept Surrealist. We see that it is a concept from AAT. The top-level concepts of the AAT subtrees from which we can select a value for style/period are shown with an underlined bold font (i.e., <styles and periods by general era> and <styles and periods by region>).

## 2.2 Searching for an image

The tool provides two types of semantic search. With the first search option the user can search for concepts at a random place in the image annotation. Figure 4 shows an example of this. Suppose the user wants to search for images associated with the concept Aphrodite. Because the ontologies contain an equivalence relation between Venus (as a Roman deity, not the planet nor the tennis player) and Aphrodite, the search tool is able to retrieve images for which there is no syntactic match. For example, if we would look at the annotation of the first hit in the right-hand part of Figure 4, we

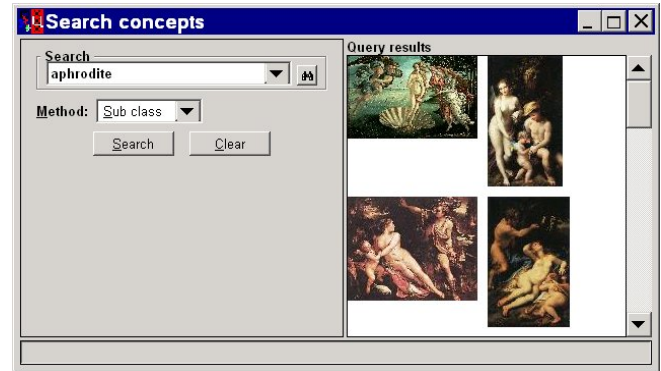


Figure 4: Example of concept search.

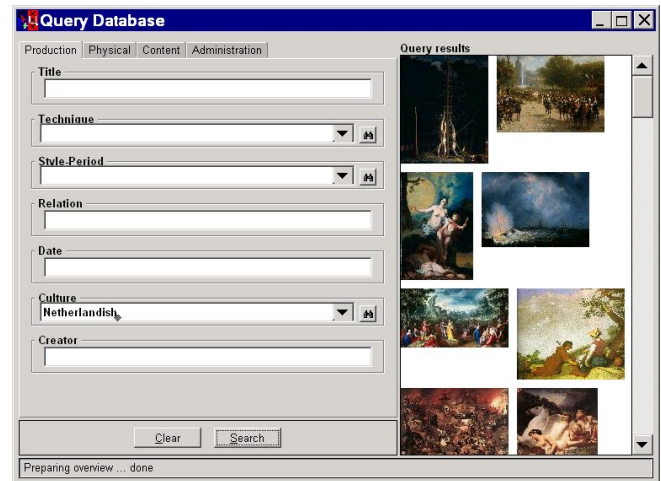


Figure 5: Search using the annotation template.

would find “Venus” in the title (“Birth of Venus” by Botticelli) and in the subject-matter description (Venus (a Roman deity) standing seashell). The word “Venus” in the title can only be used for syntactic matches (we do not have an ontology for titles), but the concept in the subject description can be used for semantic matches, thus satisfying the “Aphrodite” query.

General concept search retrieves images which match the query in some part of the annotation. The second search option allows the user to exploit the annotation template for search proposes. An example of this is shown in Figure 5. Here, the user is searching for images in which the slot culture matches Netherlandish. This query retrieves all images with a semantic match for this slot. This includes images of Dutch and Flemish paintings, as these are subconcepts of Netherlandish.

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